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| EXAMINER |
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LOEWE, ROBERT S

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| ART UNIT | PAPER NUMBER |
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1796

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09/02/2010

PAPER

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

|                              |                                      |                                    |  |
|------------------------------|--------------------------------------|------------------------------------|--|
| <b>Office Action Summary</b> | <b>Application No.</b><br>10/540,833 | <b>Applicant(s)</b><br>SATO ET AL. |  |
|                              | <b>Examiner</b><br>ROBERT LOEWE      | <b>Art Unit</b><br>1796            |  |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

#### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

#### Status

- 1) ☒ Responsive to communication(s) filed on 16 August 2010.
- 2a) ☒ This action is **FINAL**.                      2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

#### Disposition of Claims

- 4) ☒ Claim(s) 5,7,10-13 and 17-19 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 5,7,10-13 and 17-19 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

#### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

#### Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All    b) ☐ Some \*    c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

#### Attachment(s)

- |                                                                                     |                                                                   |
|-------------------------------------------------------------------------------------|-------------------------------------------------------------------|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)         | 4) <input type="checkbox"/> Interview Summary (PTO-413)           |
| 2) <input type="checkbox"/> Notice of Draftperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____                                      |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)         | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date _____                                                         | 6) <input type="checkbox"/> Other: _____                          |

## **DETAILED ACTION**

### ***Response to Arguments***

Applicant's arguments/remarks, filed on 8/16/10, have been fully considered but are not found to be persuasive. Applicants traverse the rejection made in the previous Office action to Miyahara et al. (US Pat. 5,840,830). Applicants argue that the instant process is performed in a single reactor from relatively inexpensive reactants, providing an economically viable process and that this process also affords poly(arylene sulfide) (PAS) with improved properties, including good melt viscosity, low yellowness index, low dimer byproduct, good reactivity with aminosilane coupling agents, and low volatility from the alkali metal hydrosulfide reactants.

Applicants have introduced a new process limitation to instant claim 5, namely, that the dehydration step and the subsequent polymerization steps are conducted in the same reaction vessel. Applicants cite two articles which are directed to PPS made using an advanced environmentally friendly 'one unit' process. These articles refer to PPS produced at a plant by Fortron Industries LLC which is a joint venture between the assignee of the instant application and Ticona Engineering Polymers. Presumably, these articles are used to provide evidence of the utility and beneficial environmental impact that a 'one unit' PPS production process affords. However, Miyahara teaches a process for the preparation of PPS in which the dehydration and polymerization steps may be conducted in a single reaction vessel, despite the teachings that the volatilized hydrogen sulfide ( $H_2S$ ) may be recycled into the same reaction vessel from which it was volatilized. The dehydration step still takes place in a single reaction vessel, despite the reuse of volatilized hydrogen sulfide. The remaining ingredients required for polymerization are taught to be added to the same reaction vessel in which the dehydration reaction took place. Therefore, the entire process as taught by Miyahara may take place in a single reaction vessel as required by the amended claims.

Applicants further argue that by using the claimed alkali metal hydrosulfide (MSH) and alkali metal hydroxide (MOH) as starting materials instead of an alkali metal sulfide ( $M_2S$ ), an unexpected reaction occurs between the alkali metal hydroxide and the organic amide solvent in the dehydration heat treatment to form an alkali metal alkylaminoalkanoate, and the alkali metal hydrosulfide exists in the system in the form of a complex with the alkali metal alkylaminoalkanoate. However, it is known to employ such alkali metal alkylaminoalkanoates

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as starting materials in the field of PPS preparation. Specifically, Edmunds, Jr. et al. (US Pat. 4,324,886) and Campbell (US Pat. 3,867,356) teach the reaction of organic amides [including N-methylpyrrolidone (NMP) the preferred solvent in both the instant application and Miyahara] with sodium hydroxide (the preferred alkali metal hydroxide in both the instant application and Miyahara) to afford sodium N-methyl-4-aminobutyrate (example III of Edmunds and example IV of Campbell). Campbell further teaches that improved molecular weights and yields are obtained when employing sodium bisulfide (also called sodium hydrosulfide, NaSH) and sodium N-methyl-4-aminobutyrate as starting materials as compared to employing sodium hydrosulfide and NMP as starting materials (Examples I and II). Therefore, it is believed that (1) the reaction between an alkali metal hydroxide and the organic amide solvent to produce an alkali metal alkylaminoalkanoate, and (2) the improvement in melt viscosity when the polymerization is conducted in the presence of an alkali metal alkylaminoalkanoate are not unexpected, despite Applicants' assertions to the contrary. That is to say, a person having ordinary skill in the art would have expected that a mixture of sodium hydrosulfide/sodium N-methyl-4-aminobutyrate would be present when employing NaOH and NaSH as starting materials to prepare sodium sulfide as suggested by Miyahara. Further, a person having ordinary skill in the art would have expected improved melt viscosities and yields of the PAS produced when using NaOH and NaSH as starting materials, instead of Na<sub>2</sub>S as starting material.

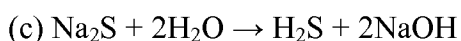
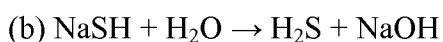
Applicants further argue that Miyahara fails to exemplify any process wherein sodium hydroxide and sodium hydrosulfide are employed as reactants as required by the instant claims. However, Applicants have already acknowledged that Miyahara does disclose this possibility in the specification (4:61-64 and 6:49-53). A reference may be relied upon for all that it teaches including nonpreferred/non-exemplified embodiments.

Applicants argue that the NaOH/NaSH ratio as exemplified by Miyahara falls outside Applicants' claimed range in the working examples (calculated to be 1.032 and 1.056; Applicants' NaOH/NaSH ratio is claimed to be from 0.95:1 to 1.02:1). However, Miyahara teaches that when an alkali metal hydrosulfide is used as a sulfur source, an alkali metal hydroxide is added in an amount **almost equimolar** thereto (6:49-51). A person of ordinary skill in the art understands that the qualitative teaching "almost equimolar thereto" captures Applicants' claimed ratio. Regarding the calculations performed by Applicants which are used to show that Miyahara

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would not satisfy the claimed NaOH/NaSH molar ratio takes into account the additional small amount of sodium hydroxide which is added in the working examples of Miyahara. However, the small amount of NaOH added by Miyahara is added **after** the dehydration step, so any calculation of NaOH/NaSH ratio must not include this additional NaOH. Without inclusion of this additional NaOH, the molar ratios as would be carried out by a person having ordinary skill in the art would likely fall within Applicants claimed ratio.

Applicants further argue that if a person having ordinary skill in the art were to employ NaOH and NaSH as starting materials as taught by Miyahara in lieu of employing Na<sub>2</sub>S as exemplified by Miyahara, the person of ordinary skill in the art would be faced with at least three chemical reactions:



Applicants argue that a person having ordinary skill in the art would not have known the extent to which each of the above reactions would occur and whether products other than the intended product would be contained in the reaction vessel and how the presence of these non-intended products would affect the polymerization to produce a PAS. Applicants then argue that one of ordinary skill in the art would normally have feared such byproducts and the detrimental effects they pose on the properties of the final PAS produced. Therefore, Applicants argue, one of ordinary skill in the art would have considered a step of removing the intended sodium sulfide product from the other products produced during the dehydration step. These arguments are not found to be persuasive for two reasons. First, reactions (b) and (c) which do not produce the desired sodium sulfide, require water as a reactant. However, the dehydration reaction as taught by Miyahara takes place with the removal of water, thereby diminishing any potential for reactions (b) and (c) to take place, as these reactions require water as a starting material. Second, the mere fact that a person having ordinary skill in the art may recognize the above reactions as taking place and further assuming that a person having ordinary skill in the art would not know how various side reactions would affect the properties of the PAS produced, does not provide disincentive for preparing the sodium sulfide in situ using sodium hydroxide and sodium hydrosulfide reactants, as Miyahara explicitly teaches that this is possible.

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Applicants assert that the above possible side reactions would cause a person having ordinary skill in the art to conduct the in situ formation of sodium sulfide in a different reaction vessel, and carry out the polymerization in another reaction vessel. However, Miyahara suggests otherwise. Specifically, Miyahara teaches that the preparation of sodium sulfide may be done in situ by reaction of an alkali hydroxide and an alkali hydrosulfide (6:48-54). Miyahara then further teaches that if the water content is too low during the dehydration step, water may be added prior to the polymerization step (6:62-65). This teaching suggests that any final modifications to the water content in the reaction vessel be done prior to addition of the dihalo-aromatic compound. This further is suggestive of a one-pot reaction wherein the dihalo-aromatic compound is added to the thus freshly prepared sodium sulfide. Finally, there are only two options available to a person having ordinary skill in the art when conducting the process as suggested by Miyahara, a one-pot process or a multiple reactor process. Given the limited number of choices, it would have been obvious to try carrying out the process as taught by Miyahara using a single reaction vessel as required by the instant claims.

Applicants also assert that Miyahara teaches that a system of two or more reaction vessels may be used (9:43-47). However, this is only one embodiment and it is clear that Miyahara also advocates the use of a single reaction vessel from the teachings at 9:43-47.

### ***Claim Rejections - 35 USC § 103***

The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 5, 7, 10-13 and 17-19 are rejected under 35 U.S.C. 103(a) as being anticipated by Miyahara et al. (US Pat. 5,840,830).

Claims 5 and 18: Miyahara et al. teaches a process for producing a poly(arylene sulfide) by polymerizing a sulfur source and a dihalo-aromatic compound in an organic amide solvent. Miyahara et al. first teaches a dehydration step whereby sodium sulfide and N-methyl-2-pyrrolidone (NMP, an organic amide solvent) are subjected to distillation, removing a part of the distillate containing water (10:55-67). The hydrogen sulfide gas which forms during this step is taught to be removed from the system. This removal of hydrogen sulfide is directly linked with a weight loss of sulfur in the reaction vessel. While Miyahara et al. teaches that the volatilized hydrogen sulfide may be recycled back into the system, this is not a teaching away from the limitation that hydrogen sulfide is discharged as a gas to the exterior of the system as required by the claims. Further, while Miyahara et al. teaches recycling of the volatilized hydrogen sulfide, said recycled hydrogen sulfide does not necessarily mean that such hydrogen sulfide is recycled back into the same system from which it was volatilized. Indeed, Miyahara et al. teaches that the recovered hydrogen sulfide may be used for other embodiments, some of which do not include re-addition to the reaction vessel from which the hydrogen sulfide was volatilized (8:19-34).

While Miyahara et al. employs sodium sulfide pentahydrate as the starting material in the working examples, Miyahara et al. does explicitly teach that the sodium sulfide can be produced in situ by reaction of sodium hydrosulfide and sodium hydroxide (4:61-64) "in an almost equimolar amount" (6:49-53). The teaching "in an almost equimolar amount" would certainly suggest to a person having ordinary skill in the art to be within the claimed mol ratio of 0.95 to 1.02 of step (1) of instant claim 5. The reaction between sodium hydrosulfide and sodium hydroxide inherently produces water, therefore, the alkali metal hydrosulfide is present as an aqueous mixture with water as required by instant claim 5. Further, Miyahara et al. teaches that the alkali metal sulfide is generally used in the form of a hydrate or aqueous mixture. Since water is inherent to the dehydration step as taught by Miyahara et al., the limitation that the alkali metal sulfide is present as an aqueous mixture with water is inherently taught by Miyahara et al. Miyahara et al. therefore effectively anticipates the process limitations corresponding to dehydration step (1) of instant claim 5.

Miyahara et al. further teaches a charging step of adding sodium hydroxide and water to the mixture remaining after the dehydration step such that the mole ratio of water to charged sulfur source is from 0.3 to 5.0 (6:61-65), which encompasses Applicants claimed ratio of 0.5 to

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2.0 moles, and that the total number of moles of NaOH to charged sulfur source may be at or very close to Applicants upper limit of the claimed ratio of 1.015 to 1.050. Using Applicants calculations for example 3a of Miyahara et al., the total number of moles of NaOH to charged sulfur source is 1.054, which is very close to Applicants upper limit of 1.050 (only a 0.004 difference in the ratio). “A prima facie case of obviousness exists where the claimed ranges and prior art ranges do not overlap but are close enough that one skilled in the art would have expected [the claimed product and a product disclosed in the prior art] to have the same properties.” *Titanium Metals Corp. of America v. Banner*, 778 F.2d 775, 227 USPQ 773 (Fed. Cir. 1985). While Applicants instant specification does exemplify several working examples having various NaOH to charged sulfur source ratios, the different NaOH to charged sulfur source ratios are much greater in the various working examples. Specifically, Applicants working examples show similar properties of the final polymers prepared when employing a NaOH/sulfur source ratio of 1.020 and 1.050, the difference between these two ratios being 0.030, which is over seven times greater than the 0.004 difference as calculated according to example 3a of Miyahara et al.

Miyahara et al. further teaches a first-stage polymerization step of adding a dihalo-aromatic compound to the mixture followed by polymerization at 180 °C to 235 °C to form a prepolymer at a conversion rate of 50-98 mol% (9:23-34). Miyahara et al. therefore effectively anticipates the process limitations corresponding to a first-stage polymerization step (3) of instant claim 5.

Miyahara et al. further teaches a second-stage polymerization step of controlling the amount of water such that there is from 2.0 up to 10 mol of water per mole of charged sulfur source with heating at 245 °C to 290 °C to continue polymerization (9:23-34). Miyahara et al. therefore effectively anticipates the process limitations corresponding to a second-stage polymerization step (4) of instant claim 5. In summary, Miyahara et al. anticipates all of the claimed process steps of instant claim 5.

The melt viscosity of the poly(arylene sulfides) taught by Miyahara et al. all fall within the claimed range of instant claim 5. While Miyahara et al. does not explicitly teach the other physical property limitations of instant claims 5 and 18, Miyahara et al. does explicitly teach all of the claimed process steps. Since the poly(arylene sulfide) as taught by Miyahara et al. and



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Applicant's disclosure are both produced in the same manner, any physical properties achieved by the compositions of Miyahara and the instant application would inherently be the same. A chemical composition and its properties are inseparable. Therefore, if the prior art teaches the identical chemical structure, the properties applicant discloses and/or claims are necessarily present. *In re Spada*, 911 F.2d 705, 709, 15 USPQ2d 1655, 1658 (Fed. Cir. 1990). See also *In re Best*, 562 F.2d 1252, 1255, 195 USPQ 430, 433 (CCPA 1977). "Where the claimed and prior art products are identical or substantially identical in structure or composition, or are produced by identical or substantially identical processes, a *prima facie* case of either anticipation or obviousness has been established." See MPEP 2112.01.

Claim 7: Miyahara et al. further teaches during the dehydration step, that the reaction mixture is heated to a temperature of 60 to 280 °C (7:11-24).

Claim 10: Miyahara et al. does not explicitly teach that the prepolymer according to instant claim 5 has a melt viscosity during the first-stage polymerization step of 0.5 to 30 Pa·s. However, the poly(arylene sulfide) as taught by Miyahara et al. and Applicant's disclosure are both produced in the same manner, therefore any physical properties achieved by the compositions of Miyahara and the instant application would be inherently be the same. A chemical composition and its properties are inseparable. Therefore, if the prior art teaches the identical chemical structure, the properties applicant discloses and/or claims are necessarily present. *In re Spada*, 911 F.2d 705,709, 15 USPQ2d 1655, 1658 (Fed. Cir. 1990). See also *In re Best*, 562 F.2d 1252, 1255, 195 USPQ 430, 433 (CCPA 1977). "Where the claimed and prior art products are identical or substantially identical in structure or composition, or are produced by identical or substantially identical processes, a *prima facie* case of either anticipation or obviousness has been established." See MPEP 2112.01

Claim 11 : Miyahara et al. further teaches after the second-stage polymerization step, (5) a separation step of separating the polymer from the reaction mixture containing the polymer, and (6) a washing step of washing the polymer thus separated with an organic solvent (9:49-64).

Claim 12: Miyahara et al. further teaches that the separation is achieved by sieving/filtering (9:49-64).

Claim 13: Miyahara et al. further teaches that the organic solvent used in the washing step is acetone (11:21-26).

Claim 17: Miyahara et al. teaches the process of instant claim 5, as described above. While Miyahara et al. does not exemplify a poly(arylene)sulfide having a melt viscosity which satisfies instant claim 7, it is believed that Miyahara et al. renders obvious this melt viscosity range. Specifically, Miyahara exemplifies polymerization at 220 °C for 4.5 hours, or polymerization at 220-260 degrees C for 1.5 hours (Table 1). However, Miyahara et al. teaches that both the polymerization times and temperatures may be longer than what is exemplified. Specifically, Miyahara et al. teaches a polymerization temperature of up to 350 °C, preferably up to 330 °C (8:65-66) and a polymerization time of up to 72 hours, preferably up to 48 hours. Increasing either the temperature of polymerization or polymerization time would be expected to increase the final melt viscosity of the poly(arylene)sulfide produced. It is submitted by the Examiner that either an increase in the polymerization temperature or an increase in the polymerization time would generate poly(arylene)sulfides of higher molecular weight, which would inherently display a higher melt viscosity. Therefore, it is believed that Miyahara et al. renders obvious the limitations of instant claim 17. It is well within the level of a person having ordinary skill in the art to carry out the polymerization reactions at various temperature and times as taught by Miyahara et al.

Claim 19: While Miyahara does not teach that during the dehydration step, the alkali metal hydroxide reacts with the organic amide solvent and forms an alkali metal alkylaminoalkanoate, and the alkali metal hydrosulfide forms a complex with the alkylaminoalkanoate as required by claim 19, Miyahara suggests carrying out the dehydration step in the same manner as the instant invention, namely the reaction of NaOH with NaSH in NMP (an organic amide solvent) for the same times and temperatures (6:43-65 and example 1a). That is Miyahara is suggestive of reacting NaOH and NaSH in the same amount of organic amide solvent (NMP) at the same time (3.5 h) and temperature (200 degrees C) as Applicants preferred embodiments. Therefore, the formation of a sodium hydrosulfide-alkylaminoalkanoate complex would be inherent to the process as suggested by Miyahara.

### ***Conclusion***

**THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

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A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

*Correspondence*

Any inquiry concerning this communication or earlier communications from the examiner should be directed to ROBERT LOEWE whose telephone number is (571)270-3298. The examiner can normally be reached on Monday through Friday from 5:30 AM to 3:00 PM EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Randy Gulakowski can be reached on (571) 272-13021302. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/R. L./

Examiner, Art Unit 1796

27-Aug-10

/RANDY GULAKOWSKI/

Supervisory Patent Examiner, Art Unit 1796